Tomosynthesis Year in Review

By Jeff Zagoudis

Digital breast tomosynthesis (DBT), also known as 3-D mammography, has come a long way since the first system received U.S. Food and Drug Administration (FDA) clearance in 2011. The modality has seen increased adoption due to the benefit of being able to see through dense fibroglandular breast tissue better than a traditional 2-D mammogram. The last 12 months have seen major developments for DBT systems, including new system launches, the inception of numerous artificial intelligence (AI) products to further enhance tomosynthesis reading and reporting, and the introduction of new quality control testing procedures.

New Releases Emphasize Workflow, Patient Comfort

Numerous clinical studies have demonstrated the benefits of 3-D mammography, so vendors are starting to target the next level of the experience for the patient and the technologist. New systems released in 2018 focused on streamlining workflow and improving the patient experience.

Siemens Healthineers received FDA clearance for its latest mammography machine, the Mammomat Revelation, last March. Many of the new features are designed to simplify the biopsy process, including HD Breast Biopsy and the InSpect integrated specimen imaging tool. The former allows easy one-click targeting of suspicious areas with +/- 1 mm accuracy, while the latter permits imaging and real-time review of biopsy samples at the workstation so the technologist does not have to leave the patient alone with their worries. The HD Breast Biopsy is made possible by the system's HD Breast Tomosynthesis technology, which offers a wide acquisition angle available at 50 degrees. This allows better separation of overlapping breast tissue for high-quality 3-D images. For the patient,

Personalized Soft Compression adjusts the level of breast compression automatically to suit each patient's anatomy.

Hologic enhanced one of its flagship mammography systems, 3Dimensions, with Clarity HD 3-D and Intelligent 2-D imaging technologies that also earned FDA approval in March 2018. Clarity HD combines a new advanced detector with a 3-D imaging algorithm to provide what Hologic calls the industry's fastest, highest resolution 3-D images to clearly reveal subtle lesions and fine calcifications. Intelligent 2-D imaging operates in tandem with Clarity HD to improve overall image quality at a lower dose. Hologic also added the SmartCurve breast stabilization system to 3Dimensions, featuring a curved compression surface to reduce pinching during the exam.

Fujifilm's newest entry to the DBT market was not a mammography system but rather a diagnostic workstation, the Aspire Bellus II. It provides a multimodality view of the patient for radiologists in a high-resolution display; users can even compare 2-D and tomosynthesis exams directly. Key features of the Aspire Bellus II include current and prior image comparison, quadrant view and invert. Reading protocols and other features can be customized for each individual user.

AI Products Enhance Tomosynthesis

Artificial intelligence (AI) has drawn more excitement than almost anything else in radiology in recent years. Machine learning and deep learning are being employed as a second set of eyes to help radiologists identify and diagnose medical problems on imaging scans, as well as in prioritizing cases to speed workflow. Several AI products introduced in 2018 were designed specifically for computer-aided detection (CAD) with tomosynthesis.

iCAD, which offers numerous CAD products for cancer detection and therapy, launched its newest offering, ProFound AI, at the end of last year. In clinical research, the solution improved cancer detection rates by an average of 8 percent while decreasing unnecessary patient recalls by an average of 7 percent. The research was performed with 24 radiologists who read 260 tomosynthesis cases both with and without iCAD's solution. ProFound AI is trained to detect malignant soft-tissue densities and calcifications, and provide a numerical score representing the likelihood of malignancy.

ScreenPoint Medical's Transpara detection and decision support solution also received FDA clearance late in 2018. Like iCAD's solution, it automatically generates a single cancer suspiciousness score by combining the findings

identified in all available views. Information is provided concurrently during reading and only when needed, so as not to slow the reading process. The clearance was supported by the results of a multi-reader, multi-case reader study, the findings of which showed stand-alone sensitivity and specificity of Transpara was nearly at the same level as that of radiologists.

ScreenPoint Medical announced at the 2018 Radiological Society of North America (RSNA) annual meeting that Transpara will soon be integrated into the syngo.Breast Care mammography reading and reporting solution from Siemens. Transpara will work alongside syngo.Breast Care's new SmartSort technology that is designed for radiologists to rank exams according to their preferences based on Transpara Scores. This will allow critical cases to be moved immediately to the top of the reading list to receive priority.

Quality Control Improvements

As with any other imaging modality or medical technology, quality control (QC) is essential for maintaining operation as well as patient safety. The FDA requires all mammography facilities with DBT systems to perform QC according to the respective manufacturer's manuals. In late July, however, the agency approved the American College of Radiology's (ACR) amendment to the 2016 Alternative Standard #24 to the "Quality control tests — other modalities" requirement. The approval means the college can incorporate DBT into the 2016 ACR Digital Mammography Quality Control Manual, and healthcare providers will be able to use the updated manual in lieu of manufacturers' manuals.

"The new DBT QC procedures in the updated ACR manual will promote uniformity of quality control since it will allow facilities to follow one manual, instead of the dozens of different manuals that are mandated for the varying manufacturers and models of digital mammography equipment with DBT," said Eric Berns, Ph.D., lead author and chair of the ACR Subcommittee on Mammography Quality Assurance. "The new manual focuses on tests that are clinically relevant for high-quality imaging and provides the structure for a thorough and complete quality control program." **itn**

Participants

Fujifilm Medical
www.fujifilmusa.com

GE Healthcare
www.gehealthcare.com

Hologic
www.hologic.com

Siemens Healthineers
www.usa.siemens.com/healthcare

Scranton Gillette Communications obtained the product specifications from the manufacturers.

Comparison chart compiled by Imaging Technology News

Scranton Gillette Communications assumes no responsibility or liability for any errors or omissions in this chart.

Comparison Chart **Breast Tomosynthesis Systems**

Company Name	Fujifilm Medical Systems U.S.A. Inc.	GE Healthcare	Hologic		Siemens Healthineers	
Product name	Aspire Cristalle	Senographe Pristina	3Dimensions Mammography System with Clarity HD high-resolution 3D imaging, Intelligent 2D imaging technology and SmartCurve Breast Stabilization System	Selenia Dimensions (3000/6000/9000) and Genius 3D Mammography exams	Mammomat Revelation	Mammomat Inspiration Prime with Tomosynthesis Option
FDA cleared, year	Aspire Cristalle 2014; Aspire Cristalle with Tomosynthesis 2017	510k - November 2016; PMA P130020/S002 - March 2017	3Dimensions FDA approved 2017, Clarity HD high-resolution 3D imaging and Intelligent 2D imaging technology FDA approved 2018	FDA PMA for tomosynthesis February 2011	2018	Tomo: 2015, Tomo only: 2016, HD Tomo Empire reconstruction and Microcalc enhancements 2017; only tomo system approved by FDA for tomo-only screening
FDA indication of equivalent/superior to FFDM	Superior to FFDM	Superior diagnostic accuracy at the same dose as 2-D FFDM	Superior to FFDM	Superior to FFDM	Superior to FFDM	Superior to FFDM
FDA approved indications for use	The system acquires and generates 2-D and 3-D images and is intended for use in the screening and diagnosis of breast cancer; each screening examination may consist of CC and MLO views from: a 2-D FFDM image set, or a 2-D and 3-D image set, where the 2-D image can be either a FFDM or a 2-D image generated from the 3-D image set	2017	The Hologic 3Dimensions system generates digital mammographic images that can be used for screening and diagnosis of breast cancer; the 3Dimensions (2-D or 3-D) system is intended for use in the same clinical applications as a 2-D mammography system for screening mammograms	The Hologic Selenia Dimensions System generates digital mammographic images that can be used for screening and diagnosis of breast cancer; the Selenia Dimensions (2-D or 3-D) system is intended for use in the same clinical applications as 2-D mammography systems for screening mammograms	FFDM, FFDM and tomo, tomo only; Synthesize 2-D and Synthesize 3-D views are available but not required	FFDM, FFDM and tomo, tomo only; Synthesize 2-D and Synthesize 3-D views are available but not required
CE mark, year	N/S	2016	2017	September 2008	2018	2006
What differentiates your product from competitors	Innovative hexagonal close pattern (HCP) detector yields more efficient capture vs. conventional square pixels, resulting in lower patient dose; Intelligent Automatic Exposure Control (iAEC) provides intelligent auto recognition of differentiating tissues, muscle and implants for optimal exposure conditions	Reshape the mammography experience with comfort, confidence and clarity; we partnered with radiologists, technologists and patients to create a mammography platform that is designed to meet each of their needs: comfort for patients: a mammography system that is more inviting and more comfortable resulting in a better overall exam experience; confidence for technologists: a new ergonomic design to reduce physical strain with dedicated functionalities for easier patient positioning	3Dimensions system is a fast, high resolution breast tomosynthesis system; the system matches the unrivaled performance of our Genius 3-D Mammography exam, which is more accurate than conventional 2-D mammograms, detecting 20-65% more invasive breast cancers.; improvements transform the patient experience without compromising on speed or accuracy	Selenia Dimensions system's Genius 3D Mammography exam offers the following advantages over 2-D mammography: an increase in invasive breast cancer detection; a reduction in false positive recalls, minimizing patient anxiety and unnecessary costs; FDA approved as superior for women with dense breasts compared to 2-D alone	50 degree angle with 25 projections for superior IQ with highest dept resolution (Z Axis) on the market; FFDM with gridless acquisition for up to 30% less dose; personalized compression; one-click targeting for biopsies; automatic breast density measurements at point of care; ability to perform dual energy exams	50 degree angle with 25 projections for superior IQ with highest dept resolution (Z Axis) on the market; FFDM with gridless acquisition for up to 30% less dose
Number of WW installs	N/S	Continuing to grow, can provide upon request	Over 6,000	N/S	>100	>3,500
Scan angle	15 degrees	25-degree sweep angle for DBT	15 degrees	15 degrees	50 degrees	50 degrees
Z Plane resolution	N/S	0.5 or 1 mm	N/S	N/S	Up to 3.5 X better resolution compared to 15 degree angle	Up to 3.5 X better resolution compared to 15 degree angle
Binning used in tomosynthesis	N/S	No binning	Standard res: Yes; with Clarity HD: no	Standard res: Yes; with Clarity HD: no	Direct 85 micron direct readout of each pixel; no binning during detector readout	Direct 85 micron direct readout of each pixel; no binning during detector readout
Detector resolution for tomosynthesis (with binning if used)	N/S	100 micron	Standard res: 100 μm; with Clarity HD: 70 μm	Standard res: 100 μm; with Clarity HD: 70 μm	85 micron tomo reconstruction for all breast sizes	85 micron tomo reconstruction for all breast sizes
Scan time, 60 mm breast	<4 sec	N/S	3.7 seconds (using Intelligent 2-D software)	3.7 seconds (using C-View software)	N/S	N/S
Tomo dose for ACR phantom	1.38 mGy	1.18 mGy	1.45 mGy	1.45 mGy	N/S	N/S
Combo dose for ACR phantom	1.38 mGy (using S-View software)	1.18 mGy using V-Preview	1.45 mGy (using Intelligent 2D software)	1.45 mGy (using C-View software)	N/S	N/S
Upgrade from FFDM	Aspire Cristalle software only; Aspire HD or HD-plus full system replacement	Software with its computer upgrade	Hardware and software upgrade	SW upgrade	SW upgrade	SW upgrade
Tomo require add-on unit or built in	Built in	Built-in	Built in - tomo only system	Built in	Built in	Built in
Reconstr time for 60 mm breast	N/S	N/S	<5 seconds	<5 seconds	N/S	N/S
Tomo-guided breast biopsy avail	Not yet available in U.S.	510K pending	Yes	Yes	Yes	No
Size of tomo screening paddles	18 x 24 and 24 x 30	Various paddle available: 24 x 29 cm; 19 x 23 cm sliding; 10 x 23 cm sliding implant/small breast paddle	Various paddles available; no limit; 18 x 24 cm, 24 x 30 cm, small breast paddle, etc.	Various paddles available; no limit; 18 x 24 cm, 24 x 30 cm, small breast paddle, etc.	25 x 36 cm (9.8" x 14.2")	24 x 30 cm, 30 x 36 cm
Tomo w/needle localiz paddles supported	No	Yes	Yes	Yes	Yes	Yes
Combo mode imaging supported	Yes	Yes	Yes	Yes	Yes	Yes, with or without Prime Technology
Compr time for combo study, 60 mm breast	N/S	N/S	~10 sec. (from initial compression to end of X-ray exposure)	~10 sec. (from initial compression to end of X-ray exposure)	27 sec	27 sec
PACS requirements	MG, BTO	Image DICOM objects MG and BTO; DICOM functions: query/retrieve, DICOM store, DICOM send, DICOM storage commitment	DICOM objects: MG, DBT, SC, GSPS; DICOM functions: Q/R, DICOM store, DICOM send, DICOM, store commit	DICOM objects: MG, DBT, SC, GSPS; DICOM functions: Q/R, DICOM store, DICOM send, DICOM, store commit	DICOM objects: MG, CT, BTO	DICOM objects: MG, CT, BTO
Generator type	High frequency	High frequency single-phase power supply	High frequency	High frequency	High frequency	High frequency
kV range	22 - 49 in 1 kV increments	22 to 49	20 - 49 kVp	20 - 49 kVp	23 to 35 (adjustable in 1 kV increments)	23 to 35 (adjustable in 1 kV increments)
mAs Range	2 - 600	4 to 600 (depending on track, filter and kV)	3 - 150	3 - 150	2 to 630	2 to 630
mA range	20 - 200	Molybdenum target: 100 mA from 25 to 30kV on large focal spot, 40 from 25 to 30 kV on small focal spot; Rhodium target: 62 mA from 25 to 30 kV on large focal spot, 35 from 25 to 30 kV on small focal spot	10 - 200	10 - 200	N/S	N/S
AEC detector	Automatic, semi-automatic, manual	Two exposure modes: automatic optimization of parameters (AOP) and manual mode available	Yes; both AutoAEC and manually select AEC regions	Yes; both AutoAEC and manually select AEC regions	Intelligent AEC algorithm analyzes each breast individually for thickness and breast composition to optimize exposure	Intelligent AEC algorithm analyzes each breast individually for thickness and breast composition to optimize exposure
Parameters controlled	Auto mode: kV, mAs, target/filter, grid, AEC, dose; semi manual and full manual modes also avail	Track, filter, kVp, mAs, AOP or manual	kVp, mAs, filter, AEC method, AEC location	kVp, mAs, filter, AEC method, AEC location	Stand: patient name, breast thickness, force in N; AWS: kVp, mAs, filter, AEC, opdose	Stand: patient name, breast thickness, force in N; AWS: kVp, mAs, filter, AEC, opdose
Breast Density and Dose Reporting						
Density reporting software	Optional VolparaDensity	Optional; Volpara Density 3-D, specifically designed and cleared fo 3-D/tomo mammography systems	Hologic Quantra breast density assessment included as standard, fully integrated on the acquisition workstation	Hologic Quantra breast density assessment software available as optional license on the acquisition workstation	Integrated with the unit as an option; system compatible with Volpara and iCAD breast density software vendors	Compatible with Volpara and iCAD breast density software vendors
What information is recorded	Breast density score correlating to BI-RADS 5th edition	Breast density score compliant with BI-RADS fifth edition	Breast density score compliant with BI-RADS fifth edition; density scores per patient and per breast	Breast density score compliant with BI-RADS fifth edition; density scores per patient and per breast	Vendor dependent	Vendor dependent

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N/A = Not applicable   N/S = Not specified

Company Name	Fujifilm Medical Systems U.S.A. Inc.	GE Healthcare	Hologic		Siemens Healthineers	
What density param are used, what is listed in the report	Breast density score correlating to BI-RADS 5th edition; volume of fibroglandular tissue, volume of breast, volumetric breast density (%)	Breast density score compliant with BI-RADS fifth edition	Breast density score compliant with BI-RADS fifth edition	Breast density score compliant with BI-RADS fifth edition	Vendor dependent	Vendor dependent
Does software record dose	Calculated AGD is recorded in the DICOM header	Dose monitoring and analytics to drive quality care	Advanced connectivity license	Advanced connectivity license	Vendor dependent	Vendor dependent
How is density infor stored/ transf	Structured report	Structured report and secondary capture	DICOM structured report and secondary capture	DICOM structured report and secondary capture	Stored with images and transferred - vendor dependent	Stored with images and transferred - vendor dependent
Digital Detector						
Type (CCD, CsI, aSe)	aSe direct-conversion	Patented needle structure CsI scintillator, single piece construction	aSe	aSe	aSe	aSe
Spatial resolution	Detection: equivalent 68 μm; image output 50 μm (2-D), 100 μm (tomo)	Native 100 μm in both 2-D and tomo modes, no binning during the acquisition process	70 μm; FFDM resolution: 70 μm; tomo resolution: 85 μm	70 μm; FFDM resolution: 70 μm; tomo resolution: 85 μm	85 microns in 2-D, 85 microns in tomo	85 microns in 2-D, 85 microns in tomo
Matrix, pixels	24 x 30 cm: 4,728 x 5,928 = 28,027,584 pixels	2,850 x 2,394 pixels; approx 13 MB per image	3,328 x 4,096	3,328 x 4,096	2,816 x 3,584	2,816 x 3,584
Standard size	24 x 30	2,850 x 2,394	3,328 x 4,096	3,328 x 4,096	2,816 x 3,584	2,816 x 3,584
High-res size	24 x 30	2,850 x 2,394	3,328 x 4,096	3,328 x 4,096	2,816 x 3,584	2,816 x 3,584
Imaging area: standard size, cm	24 x 30	24 x 29	24 x 29	24 x 29	24 x 30	24 x 30
Imaging area: high-res size, cm	24 x 30	24 x 29	24 x 29	24 x 29	24 x 30	24 x 30
Acquisition Workstation						
Workstation	Yes	Quad core Intel i5 workstation	Yes	Yes	Yes	Yes
Monitor size, inches	21.3 (3 MP)	2 types of display available: 1 MP LCD monitor; 48 cm (19") medical grade; 1,280 x 1,024 pixels (landscape); 3 MP monitor display; high performance color IPS 3 MP monitor; 54 cm (21.2"); 2,048 x 1,536 pixels (landscape)	Imaging monitor: 21.3 (2 MP/3 MP); control monitor: 17	Imaging monitor: 21.3 (2 MP/3 MP); control monitor: 17	1 MP or 3 MP, one or two monitors (optional)	1 MP or 3 MP, one or two monitors (optional)
Hard disk capacity	500 GB or higher	1 internal 250 GB disk for the system, 1 TB for image storage	1 TB (min.)	1 TB (min.)	2 TB	2 TB
Memory	8 GB or higher	32 GB	16 GB RAM (min)	16 GB RAM (min)	24 GB	24 GB
Networking capabilities	Ethernet; DICOM + IHE compliant	4 Gigabit Ethernet port; DVI display and port connector; DICOM 3.0 platform: query/retrieve modality worklist user; modality performed procedure steps; storage provider and user; storage commitment user; query/retrieve user; basic grayscale print user; verification provider; DICOM-compliant CD, DVD-R/-RW and USB data interchange	Ethernet	Ethernet	Ethernet, 100 or Gagabit LAN, DICOM 3.0 and IHE compliance	Ethernet, 100 or Gagabit LAN, DICOM 3.0 and IHE compliance
Review Workstation						
Workstation	Bellus II	Senolris Diagnose	SecurView DX	SecurView DX	syngo.Breast Care	syngo.Breast Care
Monitor size, inches	Dependant on customer requirements	Dual 5 MP 21.3" LCD display; single 12 MP 33.6" color LCD display; 19" TFT color monitor	High contrast dual 5 MP 21.3 in. LCD display with built-in auto-calibration and 10 bit graphics card; single 12 MP 33.6 in. LCD display with built-in auto-calibration and 10 bit graphics card; standard dual 5 MP 21.3 in. LCD display with 10 bit graphics card	High contrast dual 5MP 21.3 in. LCD display with built-in auto-calibration and 10 bit graphics card; single 12 MP 33.6 in. LCD display with built-in auto-calibration and 10 bit graphics card; standard dual 5 MP 21.3 in. LCD display with 10 bit graphics card	Support industry standard 5, 8 and 12 MP high resolution monitors	Support industry standard 5, 8 and 12 MP high resolution monitors
Hard disk cap	Dependant on customer requirements	1 x 256 GB, 2 x 1 TB SSD (additional 1TB opt)	Minimum 3.5 TB, RAID 5, disk encryption	Minimum 3.5 TB, RAID 5, disk encryption	Configurable to meet the enterprise class storage requirements	Configurable to meet the enterprise class storage requirements
Memory	Dependant on customer requirements	32 GB RAM	16 GB high speed RAM minimum	16 GB high speed RAM minimum	Variable, dependent on customer requirements	Variable, dependent on customer requirements
Networking capabilities	Dependant on customer requirements	10/100/1000 Base T Ethernet	10/100/1,000 Base T Ethernet	10/100/1,000 Base T Ethernet	Variable, dependent on customer requirements	Variable, dependent on customer requirements
Archive/storage	Dependant on customer requirements	Enterprise archive	SecurXchange archive	SecurXchange archive	Variable, dependent on customer requirements	Variable, dependent on customer requirements
X-Ray Tube						
Anode type	Tungsten	Dual track anode: molybenum (Mo) enriched with vanadium and rhodium (Rh)	Tungsten	Tungsten	Mo/W	Mo/W
Heat capacity, HU	300,000	Anode heat storage capacity: 250 kJ (340 kHU)	300,000 HU	300,000 HU	2,430,000 HU (tube unit)	2,430,000 HU (tube unit)
Heat dissipation rate, HU / min.	60,000	500 W (40 kHU/min)	60 kHU/min	60 kHU/min	40.5	40.5
Target/filter combo	W/Rh	Mo/Mo and Rh/Ag	Tungsten/aluminim	Tungsten/aluminim	Mo/Mo, W/RO, W/MO	Mo/Mo, W/RO, W/MO
Focal spot size, mm	0.1 and 0.3	0.1 and 0.3 IEC on each target	0.3	0.3	0.15 / 0.3	0.15 / 0.3
Radiation Shield						
L x W, cm (inches)	108 x 60.4 (42.5 x 24)	Choice between two radiation shields: integrated to the control console (height: 190 cm or 220 cm); standalone	84 W x 138 L cm	84 W x 138 L cm	86 x 195 (33.9) x (76.8)	86 x 195 (33.9) x (76.8)
Thickness	0.5 mm Pb equivalent	6 mm	12 mm leaded acrylic, 0.5 mm Pb/ 35 kV per IEC 60601-2-45	12 mm leaded acrylic, 0.5 mm Pb/ 35 kV per IEC 60601-2-45	0.5 mm lead equivalent	0.5 mm lead equivalent
Compression system	Auto and manual compression	Motorized/manual	N/S	N/S	Opcomp, intelligent compression	Opcomp, intelligent compression
Force, Newtons	0-200	Motorized up to 20 daN; Manual up to 27 daN	Manual: max 300 N; pre-compression force: 67 to 134 N; full range compression force: 89 to 178 N	Manual: max 300 N; pre-compression force: 67 to 134 N; full range compression force: 89 to 178 N	30-200 N	30-200 N
Grid ratio	6:1 41 lines/cm	Grid ratio: 11:1 in both 2D and DBT acquisitions	N/A for tomo	N/A for tomo	5:3, 31 lines/cm	5:3, 31 lines/cm
Bucky	N/A for tomo	24 x 29 cm	N/A for tomo	N/A for tomo	Reciprocating	Reciprocating
Magnification device	1.8x (for 2-D)	1.5 and 1.8 (2-D)	N/A for tomo	N/A for tomo	Optional	Optional
Stereotactic device	Optional	Yes	Affirm	Affirm	Optional	Optional
Power requirements	200/208/220/230/240V	Input frequency: 50 Hz/60 Hz; input voltage: single-phase 200-240 V~; EATON UPS 5P650 650 VA	Gantry: 2080/208/220/230/240 VAC; AWS: 100/120/200/208/220/230/240 VAC	Gantry: 2080/208/220/230/240 VAC; AWS: 100/120/200/208/220/230/240 VAC	208 V, 230 V, 240 V, 277 V, plus/minus 10%	208 V, 230 V, 240 V, 277 V, plus/minus 10%
H x W x D, cm (inches)	H 197.4 (77) W 62.4 (24.57) x D 127.4 (50)	Gantry: H 202 (80) x W 72 (28) x D 131 (5 2); acquisition station: H 188 (74) x W 77 (30) x D 37 (15)	Gantry: 66 W (26) x 223 H (87.8) x 138 D (54.25); AWS: 135.6 W (53.4) x 204 H (80.3) x 122 D (48.4)	Gantry: 66 W (26) x 223 H (87.8) x 138 D (54.25); AWS: 135.6 W (53.4) x 204 H (80.3) x 122 D (48.4)	235 (92.5) x 65 (25.6) x 117.5(46.3)	235 (92.5) x 65 (25.6) x 117.5(46.3)
Warranty	1 year	1 year system warranty standard	12 months	12 months	1 year standard	1 year standard